

AMERICAN ENTERPRISE
IN MINING MACHINERY

COPPER
SILVER
GOLD
DIAMONDS

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AMERICAN ENTERPRISE IN MINING
APPLIANCES.

FROM COPPER TO DIAMONDS.

FROM RUDE TOOLS TO MODERN MACHINERY.

This country was thrown into a whirl of excitement about 1848 by a realization of the importance of the copper discoveries. The development of the mines of the Lake Superior region gave scope for the first enterprise of Fraser & Chalmers in the manufacture of mining and metallurgical appliances. Close upon this rush to the copper mines followed the great gold excitement of California, which in a few months called three-fourths of the male population of San Francisco to the mines, and drew the adventurous from all parts of the world, giving the "Forty-Niners" a place in history. The great silver discoveries were preceded by the mining in California of cinnibar, the source of quicksilver, and culminated in the discovery at Gold Hill, Nevada, in 1859, of the "strange looking earth" which became the basis of the Comstock bonanza. These are but salient points in a series of mining fevers which excited the whole country, the last notable being that of the Black Hills, Dakota, in 1876. (See "Gold Milling in the Black Hills," by Prof. H. O. Hofman, published as No. 28 of Fraser & Chalmers' Library of catalogues and works on mining and metallurgical practice). Years after the gold excitement, California was again aroused by men who left other occupations to seek for the "green and blue carbonates, the red oxides, and the shining yellow sulphurets of copper," and it is recorded that "even smiling Napa, with its flowery meads and oak-shadowed hillsides was turned into a pandemonium of silver-mad wealth-seekers in the winter of 1858-59." But a more precious quarry was still to be sought some ten years later in South Africa, where the thrifty Boers had learned not to "laugh at the idea of selling a stone," when the stone was found to be a diamond. In 1870 the dry diggings of the African Diamond Fields proved a treasure-trove which eclipsed the splendor of all previous discoveries, and was supplemented by the finding of rich gold fields only a few years afterward.

The progress of discovery has been FROM COPPER TO DIAMONDS, an advance in preciousness fairly paralleled by the advance in the merit of improved machinery, and in power, capacity and depth of working. In this, the Fraser & Chalmers Company have been involved from first to last. They have seen the rude skid lining give place to the smoothly-timbered shaft, the rickety ladders to elevators of the most effective modern types, the awkward kibbles to easy-running skips, dumps, buckets and belt-conveyors, and the clumsy chains to steel wire cables. Hand winches and horse whims have been followed by steam power plants actuating the heaviest pumping and hoisting machinery, of which the sixty-six-ton cut-gear supplied by Fraser & Chalmers for the Diamond Mines is an example of a single member. In place of wheelbarrows, and horses and carts there are underground and surface railways, and Bleichert tramways (See catalogue booklet, No. 36). In place of the hand hammer, the pick and the crow, there are Blake and Comet crushers (See catalogues 6 and 8), and steam stamps of enormous capacity, such as those furnished by Fraser & Chalmers for the Anaconda Co., of Butte, Montana.

Inventors more ingenious than practical have beguiled the credulous investor with many devices, some of the drollest of which were diving suits, and Norwegian telescopes for exploring river-bottoms, dirt boilers, and gold magnets (which were expected to give the eager miner a heart shock in the presence of the precious metal). These fantasies and antique notions may be rated with "symbols of the dawn of science," but there has been a steady march of really scientific attainment, and now a most important development of mature science for the protection of mine investors and workers has been placed upon the market by Fraser & Chalmers in the Bridgman ore sampling machinery (See catalogue 32).

Where there was once side-hill "coyoting" with crow bars and horn spoons, there is now rapid excavation with rock drills served by powerful air-compressors (See "What the Rand Drills are Doing in Africa," F. & C. Library, No. 42); and there are deep vertical shafts with as many levels under levels of mining galleries, as a modern Chicago building has stories upon stories. (These too have been furnished with machinery by Fraser & Chalmers, notably the Masonic Temple, with its 21 stories, 17 elevators, 35 miles of piping, and 7,000 electric lights). Deep mines call for more powerful and refined hoisting equipments, and convenience and safety is obtained by the use of such appliances as Bacon's electrical chair indicator (See catalogue 21, second edition). The tendency to go deeper is nowhere more marked than at the African diamond diggings, of which it is said that there appears "no limit to the depth at which diamonds are found."

Improved machinery has repeatedly put new heart into mining by

making the unprofitable profitable, a subject, some of whose later phases are presented in McDermott and Duffield's "Losses in Gold Amalgamation," published as No. 29, and L. C. Trent's "The Combination Process," published as No. 39 of the Fraser & Chalmers Library.

In earlier times "cradles" succeeded "pans" and "bateas;" "long toms" succeeded "cradles," and sluices succeeded "toms," each change gaining an economy of three or four fold, which has been improved in a much greater ratio by placer and hydraulic mining. There has also been a notable gain in the saving results of fine concentration upon the Fruevanner (See catalogue 13). So the primitive periphery mills and arrastras have given place to modern types. The Mexican machinery of the Patio process has been greatly improved by Fraser & Chalmers (See catalogue 23). The Huntington mill (See catalogue 10) with all its distinctive features and purposes bears some analogy to the ancient arrastra, and so in another direction do the amalgamating pans, grinders and agitators which comprise the Boss continuous system (See catalogue 18). In the derivation of quicksilver from its ores, and bullion from its amalgams we have passed from the rude devices of Chard—retorts composed of old gun barrels and alembics made out of whalers' try pots to the finished retorts and bullion furnaces of Fraser & Chalmers. The improvement has been even greater in roasting, notably in the use of the Howell-White, Bruckner and Brown-O'Harra furnaces (See catalogues 4 and 20); in smelting, using water-jacket furnaces for lead and copper ores (See catalogue 3), and in the employment of converters for Bessemer-izing copper matte. There has been great advance in chlorination, in lixiviation, and in the electrolytical treatment of ore, so much that we are compelled to apologize because our descriptive literature has not kept pace with our field progress in the development of mines.

It is machinery that has made mining profitable. The wonder is, not that the wealth is in the earth, FROM COPPER TO DIAMONDS, but that the value of the constructive brain has enabled us to reach an ever-increasing enrichment. With such a preface of the glittering yet unexaggerated facts of mining machinery, we are introduced to the following description of the great South African Mines, reported from the lips of their leading engineer and manager.

[From the *San Francisco Daily Report*, 24th June, 1892.]

Gardiner F. Williams Tells of the Riches of South Africa.

THE KIMBERLY DIAMOND MINES.

RICHEST IN THE WORLD AND MANAGED BY A CALIFORNIAN—THE GREAT GOLD
FIELDS—AN OPENING FOR PACIFIC COAST LUMBER.

Gardiner F. Williams, Superintendent and General Manager of the De Beers Consolidated mines (limited) at Kimberly, South Africa, arrived here several days ago and is spending a short vacation at his old home in Oakland. The mines are the largest and richest diamond mines in the world. Gardiner F. Williams was reared in Oakland, and is a graduate of the State University. He went to Freiburg, in Germany, and took a course in the celebrated institution there, and perfected his education as a mining engineer. He was afterward engaged prominently in quartz mining in Nevada and Utah and hydraulic mining in this State, and next went to South Africa to take charge of some gold mines. While there he was engaged to superintend and manage the great diamond mines of the De Beers Consolidated Company. So much local interest attaches to these mines through Mr. Williams' connection with them that the *Report* sought and obtained the following interview with him:

A LONG JOURNEY.

"I left Kimberly on the 4th of April last," said Mr. Williams, "and came from Cape Town by the weekly line of steamers via Maderia to Plymouth, England, and thence to New York and San Francisco in the usual way. The journey was long and uneventful.

THE RICH DIAMOND MINES.

"I will first tell you something about the diamond mines. The De Beers Company was consolidated four years ago. It owns all of the De Beers and the Kimberly mines and the greater part of the Dutoits Pan and Bultfontein mines. There are a few other smaller companies operating at Bultfontein and also at Dutoits Pan. The Kimberly and De Beers are being worked entirely under ground through shafts sunk outside in the country rock. We employ in and about these two mines 1,400 white men and about 5,000 natives—Kaffirs of various tribes. About 700 of these natives are convicts. All the Kaffirs make good laborers after being once trained, especially those who remain any length of time in the company's service.

HOW NATIVE LABOR WORKS.

“We have native boys, who have been taught to handle the drill by white men, and they can drill just as well as the whites. The natives work the best on piece work. If you give them a certain task they will perform it in one-half the time it would take to do it otherwise. All our underground work is done on contract. The contracts are let at so much per load. A load is 16 cubic feet of an average weight of 1,600 pounds.

THE YIELD OF DIAMONDS.

“The output of diamonds from the mines is now limited to a great extent, so as not to send too many into the market, and to maintain prices. The yield now averages about 200,000 carats of the rough diamonds per month, and the average market price is about 30 shillings a carat. The annual expenses for the last two years have been about £1,300,000.

ENORMOUS PROFITS.

“Since I have been in charge a uniform dividend of 20 per cent. per annum has been paid to the shareholders, in semi-annual payments. For the last six months the dividend was increased to 25 per cent. The company is incorporated under the local laws, and is purely a local concern, with its head office in Kimberly. The shareholders principally live in Europe, and many are old colonists.

PONDEROUS MACHINERY.

“The machinery at the Kimberly mine for the pumping is a triple-expansion engine, driving a 14-inch set of pumps of the Cornish type. This engine is fitted with a spur gear wheel built by Fraser & Chalmers, Chicago. Its diameter is 30 feet. Six average men stood one upon another would about equal its height. The wheel has 192 machine-cut teeth of 6 inches pitch. Its face is 30 inches, its hub 9 feet 2 inches diameter, with a bore of 27 inches. The hub weighs 15 tons, and the whole wheel built up in twelve segments weighs sixty-six and two-thirds tons. To guard against possible breakage, an extra arm and segment was furnished, required to fit perfectly and be interchangeable in the place of any one of the twelve segments.

The pumps work to a depth of 1,200 feet, at which depth a tunnel is being run to the mine, a distance of 1,150 feet. A tunnel at the 1,000 feet level has already reached the diamond-bearing ground. We have also, for hoisting, (or winding, as we call it), Corliss engines with double-tandem compound cylinders. Flat wire rope is used. The hoisting of the ore is done by means of automatic self-dumping skips, similar to those used on this coast.

ENORMOUS HOISTING CAPACITY.

“The greatest amount of diamond-bearing rock hoisted through one shaft in twenty-four hours is 4,977 tons. This comes from a vertical depth of 700 feet, through an incline shaft, the running distance in the shaft being 840 feet. The weekly output of the De Beers mine is 29,000 tons, and that of the Kimberly mine is 18,000 tons, and the quantity from the Kimberly will be increased as soon as the new machinery is in working order.

HOW DIAMONDS ARE EXTRACTED.

“The diamond-bearing rock after being hoisted is deposited upon floors, which are made by clearing off the grass and leveling the surface of the ground. The material remains upon these floors for from four to eight months to allow it to disintegrate or slake, which it does by exposure to air and moisture. The material is then taken to washing machines, where the diamonds are separated from the mass of stuff by gravitation. For every 100 tons washed about one ton of concentrates remains. The concentrates are taken to a pulsating machine, or what you call out here, a ‘jig works,’ where the material is further concentrated. From this machine the residue of the concentrates, with the other material heavier than the diamonds is taken to sorting tables, and sorted first by whites and then by natives. The diamonds are then taken to the general offices, assorted and sold to the agents of the large European buyers who live in Kimberly.

HOW DIAMONDS ARE SHIPPED.

“The diamonds thus bought are shipped by mail train every week. They go by the registered letter post, at the same rate as the regular letter postage. As a matter of course they are well insured. They are shipped to England via Cape Town.

A MONSTER DIAMOND.

“We have found, of course, some very large diamonds. The largest weighed in the rough $428\frac{1}{2}$ carats, and measured one inch and three-quarters through its longest axis. It was retained by the company, and was sent to Amsterdam to be cut, and was on exhibition at the last Paris Exposition. It was recently sold to people in India for £14,000, or \$70,000.

PATRONIZING CHICAGO.

“We are now having made in Chicago, by the great firm of Fraser & Chalmers, four triple expansion engines to replace the old ones in use. This will effect a great saving in the consumption of fuel. All the coal used at the diamond mines is imported from England and costs us £8 10s, or \$42 per ton. The De Beers and Kimberly mines burn from 1,500 to 1,800 tons of coal per month.

A WORLD'S FAIR EXHIBIT.

“We are arranging for a special exhibition at the World's Fair to be held in Chicago, which will show the process of washing out and assorting the diamonds. We will exhibit about 150 tons of diamond-bearing rock in the different stages of working, and will also have a diamond-cutting establishment in connection with the exhibition. Arrangements are now being made with Tiffany & Co., of New York, to supply the men and the machinery for the cutting of the diamonds. We preferred to have Tiffany & Co. control the diamond cutting, for the great fair will be an American institution, and this country should get the benefit of it as much as possible. We will also exhibit at the fair 10,000 carats of rough and uncut stones.

THEFTS OF DIAMONDS.

“Great care is taken at the mines to prevent the stealing of diamonds. In former times the thefts amounted to one-fifth of the value of all the diamonds found at Kimberly, and the stolen gems were sent out of the country through illicit channels. The thefts have been very greatly reduced by what we call ‘compounding’ the natives. A ‘compound’ is a large inclosed area in which the natives are required to live, and they cannot pass out during their term of service. All food and other necessities of life are supplied to the natives within these inclosures.

BUYING CALIFORNIA LUMBER.

“We are about to make an experimental shipment of California lumber to the mines,” continued Mr. Williams. “Nearly all our lumber now comes from the Baltic sea and costs 17 cents per running foot of 3x9 inches. One-half of the expense is in the carriage of the lumber inland to the mines. We think we can do better with Pacific coast lumber, and as soon as we can get a ship we will send down 1,000,000 feet as an experiment. It may be the means of opening up a large trade in lumber, of which this coast will get the benefit. The Baltic lumber, with the exception of big square timbers, is all of the uniform measurement of 3x9 inches, varying in length up to thirty feet. Round timber for posts and caps costs 72 cents per cubic foot at the mines.

“I think that Pacific coast lumber can be laid down at Port Elizabeth for less than the Baltic and is a better class of timber. That from Puget sound averages better in strength than such Baltic lumber as we get.

SOUTH AFRICAN GOLD FIELDS.

“The South African gold fields are about 280 miles from Kimberly. The principal district is at Johannesburg. The gold product of the mines

is increasing and has grown steadily month by month from 40,000 ounces to 95,000 ounces in April last. It is expected to reach 100,000 ounces or more per month, and to be maintained. The ore veins are composed of cemented quartz gravel. At the depth of 150 feet the decomposed ore changes to an iron sulphuret. The free gold in the sulphuret seems to be nearly as great as in the upper levels. The sulphurets carry 12 to 15 ounces gold. The deepest works are 600 feet, where a prospect shaft is being sunk to develop one of the mines. Under the laws of the Transvaal the locations are on a square basis. Claims are located 150 feet long and the boundaries on the four sides are vertical to all depths, so that all veins passing outside of the vertical boundary lines becomes the property of those making the side locations. Deep bore holes are being sunk to test the mines at greater depth. The veins dip at an angle of 45 degrees. Many new companies are being organized to develop the district.

CHICAGO MACHINERY AGAIN.

“The gold mines are equipped with the best machinery and the best mills. Fraser & Chalmers of Chicago are having built many mills of from 120 stamps capacity down. These mills crush an average of five tons of ore per stamp per day of twenty-four hours. They have also new chlorination works, especially at the Robinson mine, which are equal to if not better than any in the world. They are being erected by Charles Butters of California, a graduate of the State University, who went out for the special purpose of putting them up. The gold in the ores from the upper levels is so exceedingly fine that the loss in the tailings after amalgamation is great. The general management of the machinery and the workings at many of the mines is in the hands of Hennen Jennings, who was formerly in the employ of the Quicksilver Mining Company at New Almaden, Cal.

“The mines are well supplied with white labor, and the wages range from \$2.50 to \$3.50 per day for miners. The country in fact is full of men from England. There are California miners at Witwatersrandt.

“The climate both at Kimberly and at the gold mines is good. In fact it is better than in the Sacramento valley and lower foot hills. There is a very even temperature at the gold fields. There is no snow or extreme cold at Kimberly, and the thermometer seldom rises above 98 degrees.

“The district of Kimberly had a population according to the last census of 48,000, of which 12,000 to 15,000 are whites.”

Mr. Williams has been connected with the diamond mines since May 1, 1887, and this is his first visit here in five years. He will leave here on his return to the mines next month.

FRASER & CHALMERS' PRODUCTS AND CATALOGUES.

SYNOPTICAL LISTS.—In the following lists, references in parenthesis are to the numbers of our catalogues, whose new issues mark the practical course of mechanical and metallurgical progress. We solicit inquiries from interested parties:

MINING AND POWER MACHINERY.

Steam Power Machinery.—Corliss Engines (No. 12); Steam Boilers, Slide Valve and Portable Engines, (No. 1).

Hoisting and Mine-Shaft Machinery.—Hoisting Engines, Fraser's Friction Drums, Winches, Cages, Landing Dogs, Buckets, Skips, (No. 1); Safety Appliances, Bacon's Electrical Chair Indicators, (No. 21).

Elevators of all descriptions.

Tramways and Conveying Machinery, (No. 1).—McCaskell Wheels and Axles, (No. 17); Bleichert Rope Tramways, (No. 36); Eliot Wire Rope, (No. 37).

Mill Gears, Pulleys and Shafting.

Cable Railway Machinery.—Complete Equipment of Cable Roads.

Electric Railways.—Motors and Machinery for Entire Installations.

Shay Locomotives, Logging Roads and Saw Mill Machinery.

Blowing Machinery.—Corliss Blowing Engines, (No.); Pressure Blowers, (No. 3 and No. 34); Mine Ventilators, (No. 38).

Rock Drills and Air Compressors, (No. 1 and No. 35); Core Drills for Prospectors.

Pumping Machinery.—Cornish Pumps with Corliss Engines, (No. 1); Knowles Pumps, (No. 30); Blake Pumps, (No. 31); Reidler Pumping Engines.

Water Wheels.—Pelton Wheels and Motors, (No. 19); Leffel Turbines, (No. 33).

Pipe, Pipe Fittings, and Fitters', Blacksmiths' and Millwrights' Tools, (No. 5).

Electric Lighting Plants for Mines and Mills: Arc and Incandescent Lights.

METALLURGICAL PLANTS FOR THE TREATMENT OF ORES.

Sampling and Assaying.—Ore Treatment, (No. 26); Losses in Gold Amalgamation, (No. 29); The Combination Process, (No. 39); Sampling Works, (No. 3); Assay Outfits, (No. 25); Bridgman's Ore Sampling Machines, (No. 32).

Crushing and Pulverizing Machinery, (No. 8 and No. 9); Comet Crushers, (No. 6); Huntington Mills, (No. 10); Sturtevant Pulverizers, (No. 11); Patio Process Machinery, (No. 23).

Stamp Milling.—Steam Stamps, Stamp Mills, (No. 4); Automatic Ore Feeders, (No. 16); Chrome Steel Shoes and Dies, (No. 14); "Gold Milling in the Black Hills," (No. 28).

Concentrating Machinery, (No. 9); Frue Vanners, (No. 13); Howland Riffles, (No. 22); Perforated Metals, (No. 7); Wire Cloth, (No. 15).

Roasting Milling.—Kilns, Driers, and Stetefeldt, Howell-White and Brown-O'Harra Roasting Furnaces, Reverberatory Furnaces, (No. 4); Bruckner Furnaces, (No. 20).

Chlorination Milling.—Generators, Tanks and Appliances of the Most Improved Types, (No. 4).

Lixivation Milling.—Leaching, and Precipitating Tanks and all Apparatus, (No. 4).

Amalgamation.—Wet Crushing Silver Mills, Standard Pans and Settlers, (No. 4); Boss' Continuous System, (No. 18); Jordan Amalgamators, (No. 43).

Smelting.—Reverberatory and Bruckner Furnaces, Water Jacket Furnaces for Lead and Copper Ores, (No. 3); Furnaces with Improved Fore-Hearths, Slag Escapes. See "Information on Smelting Ore," (No. 27).

Refining and Melting.—Cupelling Furnaces, (No. 3); Retorts and Bullion Furnaces, (No. 4).

Electrolysis.—Electrolytical Copper Plants, Parting Plants for Gold and Silver Bullion, according to improvements of Moebius.

